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ABSTRACT

The document is one of five summary reports, all part of a Pre-Technical Curriculum Planning Project for secondary students who aspire to technical employment or post secondary technical education. This report represents the results of an assessment of the northeast Florida area's technical occupations in engineering and industrial fields. A three-phase approach was utilized: (1) the identification of four broad career clusters in electromechanical, building and construction, climate control, and transportation fields; (2) development of a survey instrument; and (3) a review of data collected. The following occupations are analyzed according to tasks and corresponding skills/knowledges: electronics technicians, electronics maintenance, sales, radio and television repair, electromechanical technicians, computer maintenance, air conditioning service, heating and power plant technician, sheet metal work, automotive repair, service station business management, drafting, surveying, electrical trades and mechanical trades, such as plumbing and industrial sheet metal work. Employment statistics and projections, conclusions and recommendations complete the document. (MW)

SUMMARY REPORT

TECHNICAL EMPLOYMENT IN NORTHEAST FLORIDA

ENGINEERING AND INDUSTRIAL FIELDS

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DUVAL COUNTY SCHOOL BOARD
PRE-TECHNICAL CURRICULUM
PLANNING PROJECT - ESEA TITLE III

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INTRODUCTION

In 1971, the Duval County School Board took a major step forward in providing relevant curriculum for students when they adopted the concept of a three-program curriculum for its senior high schools. The three programs decided upon by the Board were:

1. Vocational
2. College Preparatory
3. Pre-Technical

The differences between this high school curriculum and most others were that:

> The pre-technical program filled the gap between the vocational and the professional level preparation.
>
> Each of the three programs was directly related to the student's post high school plans.

The traditional programs and curriculum had made available programs that would provide the skills and knowledges for pupils desiring to enter a vocation or college, but only a few technical, and no pre-technical courses were offered.

This lack of a pre-technical curriculum was not a problem unique to Duval County schools. Investigations by staff members of the Duval County School Board of existing problems at the local and state levels, followed by consultations with state and national experts in technological education, revealed that no planned program of pre-technical education at the secondary level existed in the state or in the nation. Only fragments of a pre-technical curriculum, and a few high

school technical programs, could be found. The failure of education on a national scale to respond to the needs of certain students, industries, and businesses emphasized the requirement for a carefully prepared pre-te. .cal curriculum at the secondary level.

Education's failure to meet the need for technical and pre-technical education provided the impetus for this project. The project's ultimate goal is to develop a pre-technical curriculum which would provide secondary students, who aspire to technical employment or post secondary technical education, with the requisite skills, knowledges, and attributes to respond successfully to current and anticipated demands of local, state, and national job markets.

Before any curriculum could be developed, an assessment had to be made of the kinds of technical occupations that presently exist in the Northeast Florida area plus the associated skills, knowledges, and attributes needed for these occupations. This summary report presents the results of that assessment.

The study was limited to the Northeast Florida area and to selected agencies because of time and personnel constraints. However, there is no apparent reason why the procedures used in this study would not be applicable to a wider geographic region.

DESIGN OF THE STUDY

This study was designed to meet the following objectives with respect to occupations in the Engineering and Industrial Area in Northeast Florida:

1. To identify the existing technical occupations and the number of present and anticipated employees in each.
2. To determine the requisite skills, knowledges, and attributes associated with successful participation in each occupation identified in (1).
3. To cluster the technical occupations.

The scope of the study required a three phase approach.

Phase I was the identification of four broad career clusters in the Engineering and Industrial Field. They are:

1. Electro-Mechanical
2. Building and Construction
3. Climate Control
4. Transportation

Special Area Advisory and Review Committees were established in each of the clusters. Each committee was composed of:

1. area specialists from Florida Junior College and the Duval County School Board
2. working technicians
3. key representatives from the Industrial sector of Duval County.

The first function of each committee was to prepare

a rough draft survey form of tasks performed in each cluster area. A tentative list of skills, knowledges, and attributes was also identified at this time. The project staff was responsible for researching the literature and making resources available to assist the committee members in this endeavor. After preparing the survey instrument for each area, the committee members identified key representatives from the Engineering and Industrial Field in Duval County, which employed personnel in technical positions and then identified key individuals within those agencies. These key individuals were contacted by staff personnel and a job task survey instrument was completed for the technical occupations existing in the employing agency. At least one of the following methods was used to complete the survey instrument for each occupation.

1. Completed by technicians supervisor.
2. Completed by technician.
3. Completed by personnel office staff.
4. Completed by project staff member from available job description information.

Phase II consisted of identifying the number of present and anticipated employees in each job. Three sources were utilized: 1) Committee members, 2) existing surveys, and 3) a written survey instrument.

Considerable difficulty was encountered in the attempt to collect this data, even though a statement was made to the effect that information obtained would not be released associating companies and numbers of technical employees.

This statement was not accepted by some companies and union officials.

The basis for determining the number of present employees in the Engineering/Industrial Field is the State Department of Education Florida Technician Man-Power Survey (July, 1971).

Additional information concerning the number of technicians in Duval County was secured through committee members, personal contacts, responses from the survey letters, and telephone contacts. The number of employees reported in Chapter V is considered representative, but not all inclusive.

In Phase III, members of the Special Area Advisory Committees met to review the data collected to date. Task forces composed of consultants and members of each area advisory committee met individually and in some cases jointly, to expand and compile the lists of tasks, and skills, in each of the four areas. Based on these lists, a final review and modification was made by selected committee members. The results of that review are shown in Chapters 1-5 of this report.

CHAPTER I

IDENTIFICATION OF TECHNICAL OCCUPATIONS

ENGINEERING AND INDUSTRIAL

This chapter presents the listing of entry level and specialized technical occupations presently existing in Northeast Florida. The gathering of data from which the lists were derived was a continuing activity of the staff and members of the various advisory committees during Phase I and II.

The majority of the occupations given in the Engineering and Industrial Areas were identified by members of the specialized Advisory Committee. Personal visits to selected businesses in each area completed the identification of occupational titles.

No attempt was made by the staff or committees to interpret what was meant by various job titles or occupations. The common titles currently in use by governmental agencies or businesses were used, as were the job titles listed in the Dictionary of Occupational Titles. The table below summarizes the number of occupations identified in each major area.

Area	Number of Occupations Identified
I. Electro-Mechanical	
A. Electronics	5
B. Electro-mechanical	3
II. Climate Control	5
III. Transportation	7

IV. Building and Construction

A.	Drafting	5
B.	Electrical	6
C.	Mechanical	7

CHAPTER II

TASK ANALYSIS OF SELECTED OCCUPATIONS IN ENGINEERING AND INDUSTRIAL RELATED BUSINESSES

In this chapter, a task analysis for each technical occupation is given. Section I is a task analysis for occupations in Electro-Mechanical, Section II is a task analysis for occupations in Climate Control, Section III is a task analysis for occupations in Transportation, and Section IV is a task analysis for Building and Construction. Each section lists the occupation and its identifying code title. An (X) appearing in the column opposite the task row for a particular occupation indicates that that task is performed in the occupation.

These task lists were compiled from information and surveys conducted in Phases I and II. The original task lists were developed by task forces composed of members of the various advisory committees from job descriptions and publications available on competencies found in Engineering and Industrial careers. From the original task lists, a written survey instrument was developed which could easily be completed by anyone familiar with the occupation. Selected businesses were identified who employed individuals in technical positions. They were contacted by a staff member, and at least one of the following methods was used to complete the survey instrument:

1. Completed by technicians supervisor.
2. Completed by personnel office staff.
3. Completed by project staff member from available job description information.

An attempt was made to obtain at least three completed surveys on each occupation. A consensus of individuals who completed the survey provided the basis for listing that task as being performed in that occupation.

CHAPTER II

TASK ANALYSIS

ENGINEERING AND INDUSTRIAL

I. Positions in Electro-Mechanical (Entry level and specialized positions)

A. Electronics

Title:	Code:
Electronics Installation Man	1
Communications Technician	2
Industrial Electronics Maintenance Man	3
Electronics Salesman	4
Radio & T.V. Repairman	5

B. Electro-Mechanical

Title:	Code:
Instrument Repairman	1
Machinery Maintenance Man	2
Computer Maintenance Man	3

I. ELECTRO-MECHANICAL

A. ELECTRONICS

JOB ENTRY TASKS	CODE 1	2	3	4	5
1. Satisfy the physical requirements of the job.	X	X	X	X	X
2. Follow, practice safe procedures and practices.	X	X	X	X	X
3. Use and care for common and specialized hand tools and power tools.	X	X	X		X
4. Use proper soldering techniques.	X	X	X		X
5. Read and interpret electronic symbols.	X	X	X	X	X
6. Read and interpret electro-electronic schematic diagrams.	X	X	X	X	X
7. Read and interpret blueprints.	X	X	X	X	
8. Operate precision measuring test equipment.	X	X	X		X
9. Read color code and markings on electronic components.	X	X	X	X	X
10. Design a basic electronic circuit.	X	X	X	X	X
11. Construct a basic electronic circuit.	X	X	X		X
12. Modify circuits to meet changing situations.	X	X	X		
13. Test and service electronic equipment.	X	X	X		X
14. Trouble shoot an electronic device.	X	X	X		X
15. Read instruction manuals, directions, and other written material for precise content.	X	X	X	X	X
16. Analyze and interpret information obtained from precision measuring and recording instruments.	X	X	X	X	
17. Deal with a variety of technical problems involving many factors and variables.	X	X	X	X	
18. Repair or replace defective parts or systems in electronic devices.	X	X	X		X
19. Plan, install, and inspect the installation of complex equipment.	X	X			

I. ELECTRO-MECHANICAL

A. ELECTRONICS

JOB ENTRY TASKS	CODE 1	2	3	4	5
20. Perform routine maintenance to maintain equipment efficiency.		X	X		X
21. Organize manpower needs for most efficient operations.	X	X	X		
22. Develop material, supply, tool, and equipment list for a job.			X		X
23. Make technical evaluations and call consultant as required.	X	X	X	X	
24. Keep current on new developments in technology.	X	X	X	X	X
25. Prepare or interpret engineering drawings and sketches.	X	X	X	X	X
26. Advise, plan, and estimate costs of equipment and stock.	X			X	X
27. Administer first aid and abide by 1971 Health and Safety Act.	X	X	X		
28. Write clear and concise communications.	X	X	X	X	X
29. Communicate instructions and ideas orally.	X	X	X	X	X
30. Demonstrate effective relations with customers and suppliers.	X	X		X	X
31. Maintain effective relations with superiors and coworkers.	X	X	X	X	X
32. Work cooperatively with inspection personnel and engineers.	X	X	X	X	X

I. ELECTRO-MECHANICAL

B. ELECTRO-MECHANICAL

JOB ENTRY TASKS	CODE 1	2	3
1. Satisfy the physical requirements of the job.	X	X	X
2. Mathematically plan and analyze work.	X	X	X
3. Render technical assistance to craftsmen.	X	X	X
4. Use properly the available hand and power tools associated with the electro-mechanical field.	X	X	X
5. Use techniques of soldering, welding, and other skills associated with the field.	X	X	X
6. Operate precision measuring test equipment.	X	X	X
7. Identify common use hardware and equipment.	X	X	X
8. Interpret, analyze, and transmit facts and ideas graphically, orally, and in writing.	X	X	X
9. Prepare appropriate technical reports.	X	X	X
10. Read and interpret electro-mechanical blueprints, drawings, schematics, graphs, line diagrams, and bulletins.	X	X	X
11. Select, compile, and use technical information from current references.	X	X	X
12. Install electro-mechanical equipment according to existing codes.		X	X
13. Determine the most economical and efficient materials and methods of installation.		X	X
14. Test installations using the appropriate equipment and procedures.	X	X	X
15. Design and construct basic electro-mechanical systems.	X	X	X
16. Perform instrumental tests on mechanical, hydraulic, pneumatic, electrical or electronic components of industrial equipment.	X	X	X

I. ELECTRO-MECHANICAL

B. ELECTRO-MECHANICAL

JOB ENTRY TASKS	CODE 1	2	3
17. Using appropriate tools and equipment, disassemble and repair electro-mechanical equipment.	X	X	X
18. Replace defective parts or systems.	X	X	X
19. Perform routine preventive maintenance on electro-mechanical equipment and develop appropriate maintenance program to keep equipment operable and efficient.	X	X	X
20. When required, recommend changes for improvement of existing systems.	X	X	X
21. Assist in developing materials, supplies, tools, and equipment needs for a job.	X	X	X
22. Assist in ordering job needs and estimating costs using approved practices.	X	X	X
23. Provide required data for cost accounting systems.	X	X	X
24. Assist in maintaining inventory control.	X	X	X
25. Schedule equipment and materials for efficient use.	X	X	X
26. Assist in planning production as a member of the management unit.			X
27. Establish procedures for the most economical use of employees under his control.	X	X	X
28. Keep fully informed of all safety precautions and proper procedures pertaining to his work.	X	X	X
29. Plan a safety program for each job.	X	X	X
30. Administer first aid as required by Federal Act.	X	X	X
31. Demonstrate effective relationships with customers and suppliers.	X	X	X
32. Maintain effective relations with superiors, coworkers, subordinates, inspection personnel, and engineers.	X	X	X

CHAPTER II

TASK ANALYSIS

ENGINEERING AND INDUSTRIAL

II. Positions in Climate Control (Entry level and specialized positions)

Title:	Code:
Air Conditioning, Refrigeration and Heating Serviceman.....	1
Leader Man - Foreman.....	2
Estimator.....	3
Heating & Power Plant Technician.....	4
Sheet Metal Man.....	5

II. CLIMATE CONTROL

JOB ENTRY TASKS	CODE 1	2	3	4	5
1. Use and care for common and specialized hand tools and power tools.	X	X		X	X
2. Use and care for the general and specialized test equipment, service equipment and installation equipment.	X	X		X	
3. Use welding equipment to cut, weld, braze, and solder.	X	X		X	X
4. Satisfy the physical requirements of the job.	X	X		X	X
5. Maintain personal health.	X	X	X	X	X
6. Apply mathematical knowledge to measurement, installation of equipment and evaluation of test results.	X	X	X	X	X
7. Install all types of air conditioning, refrigeration, heating, and ventilating equipment in accordance with national and local codes.	X	X		X	
8. Utilize knowledge of refrigeration principles to test and service all types of installation.	X	X		X	
9. Utilize knowledge of electricity to connect, test, and service climate control equipment.	X	X		X	
10. Utilize knowledge of refrigeration principles, heating system principles to test and service all types of installations.	X	X		X	
11. Plan and install duct systems for distribution of heating and cooling mediums.	X	X			X
12. Compute heat gain and heat loss for commercial and residential buildings.		X	X		
13. Modify existing air conditioning, refrigeration, heating, and ventilating systems.		X	X		
14. Read and use plans and material specifications	X				
15. Read and use electrical schematics, wiring diagrams and piping diagrams.	X	X	X	X	X

II. CLIMATE CONTROL

JOB ENTRY TASKS	CODE 1	2	3	4	5
16. Develop material, supply, tool and equipment requirement lists for the job.	X	X	X	X	X
17. Keep current on new developments in the technology.	X	X	X	X	X
18. Maintain inventories on truck and shelf.	X	X		X	X
19. Organize manpower needs for most efficient operations.		X	X		
20. Schedule equipment and materials for efficient use.		X	X		
21. Provide required data for cost accounting systems.	X	X	X	X	X
22. Satisfy state and local insurance and bond standards.		X	X		
23. Plan safety program for each job and follow safe practices and procedures.	X	X		X	X
24. Administer approved first aid as required.	X	X		X	X
25. Write clear and concise communications.	X	X	X	X	X
26. Orally communicate ideas and instructions.	X	X	X	X	X
27. Read instruction manuals, directions, and other written material for precise content.	X	X	X	X	X
28. Instruct and direct activities of subordinates.	X	X		X	X
29. Demonstrate effective relationships with customers and suppliers.	X	X	X	X	X
30. Maintain effective relations with superiors and coworkers.	X	X	X	X	X
31. Work cooperatively with inspection personnel and engineers.	X	X	X	X	X

CHAPTER II

TASK ANALYSIS

ENGINEERING AND INDUSTRIAL

III. Positions in Transporation (Entry level and specialized positions)

Title:	Code:
Automotive Technician.	1
Engine Mechanic.	2
Service Station Business Man	3
Truck and Equipment Mechanic	4
Service Representative	5
Operating Engineer.	6
Air Frame and Engine Mechanics.	7

III. TRANSPORTATION

JOB ENTRY TASKS	CODE 1	2	3	4	5	6	7
1. Satisfy the physical requirements of the job.	X	X	X	X	X	X	X
2. Follow safe practices and procedures.	X	X	X	X	X	X	X
3. Satisfy local, state, and national legal requirements.	X	X	X	X	X	X	X
4. Operate equipment in a safe and efficient manner.	X	X	X	X	X	X	X
5. Use and care for common and specialized hand and power tools.	X	X	X	X		X	X
6. Use and care for test equipment, maintenance, and overhaul equipment.	X	X	X	X			X
7. Apply mathematical knowledge to measuring, computing, and problem solving.	X	X	X	X	X	X	X
8. Apply the knowledge of physics and chemistry to understanding machinery and correcting problems.	X	X	X	X	X	X	X
9. Use welding equipment.	X	X	X	X			
10. Read and interpret drawings, schematics, piping diagrams, exploded views, and pictorial representations.	X	X	X	X	X	X	X
11. Repair conventional gasoline engines and associated equipment.	X	X	X				X
12. Use plot plans and surveyor's grade stakes.						X	
13. Repair diesel engines and associated equipment.				X			
14. Repair turbine engines and associated equipment.							X
15. Repair power transmission equipment.	X		X			X	X
16. Repair steering control and suspension systems.	X		X	X			X

III. TRANSPORTATION

JOB ENTRY TASKS	CODE 1	2	3	4	5	6	7
17. Straighten and align metal parts.	X						X
18. Apply protective coatings and paint.	X		X	X		X	X
19. Install and service accessory equipment.	X	X	X	X		X	X
20. Examine equipment and parts for wear and adjustment recommending corrective procedures.	X		X		X		X
21. Conduct routine in-service inspections and keep records of data obtained.	X	X	X	X		X	X
22. Develop material, supply, tool and equipment requirement lists for a job.							
23. Keep current on new developments in the technology.	X	X	X	X	X	X	X
24. Maintain parts inventory.	X	X	X	X			
25. Organize manpower needs for most efficient operations.	X		X	X		X	X
26. Plan safety program and implement.	X	X	X	X		X	X
27. Administer first aid as required.	X	X	X	X		X	X
28. Write clear and concise communications.	X	X	X	X	X	X	X
29. Orally communicate ideas and instructions.	X	X	X	X	X	X	X
30. Read instruction manuals, directions, and other written material for precise content.	X	X	X	X	X	X	X
31. Demonstrate effective relationships with customers and suppliers.	X	X	X	X		X	X
32. Maintain effective relations with superiors, coworkers, subordinates.	X	X	X	X	X	X	X
33. Work cooperatively with inspection personnel and engineers.	X				X	X	X

CHAPTER II

TASK ANALYSIS

ENGINEERING AND INDUSTRIAL

IV. Positions in Building and Construction (Entry level and specialized positions)

A. Drafting

Title:	Code:
Architectural Draftsman	1
Civil Draftsman	2
Electrical Draftsman	3
Mechanical Draftsman	4
Surveyor	5

B. Electrical

Title:	Code:
Construction Electrician	1
Industrial Electrician	2
Electrical Estimator	3
Electrical Saleman	4
Electrical Inspector	5
Electrical Trainee	6

CHAPTER II

TASK ANALYSIS

ENGINEERING AND INDUSTRIAL

IV. Positions in Building and Construction (Entry level and specialized positions)

C. Mechanical

Title:	Code:
Utility Technician	1
Plumber & Pipefitter	2
Industrial Sheet Metal Mechanic	3
Steamfitter	4
Mechanical Estimator	5
Mechanical Inspector	6
Mechanical Trainee	7

IV. BUILDING AND CONSTRUCTION

A. DRAFTING

JOB ENTRY TASKS	CODE 1	2	3	4	5
1. Use and care for instruments and equipment, including all types of measurement devices.	X	X	X	X	X
2. Letter dimensions and notes on drawings.	X	X	X	X	X
3. Construct geometric figures.	X	X	X	X	X
4. Construct multi-view drawings using the system of orthographic projection.	X	X		X	
5. Dimension drawings.	X	X	X	X	X
6. Make orthographic or pictorial freehand sketches.	X	X	X	X	X
7. Construct sectional views.	X	X		X	
8. Construct primary auxiliary views.	X	X		X	
9. Construct secondary auxiliary views.	X	X		X	
10. Draw threaded fasteners.				X	
11. Draw permanent fasteners and welding symbols.	X			X	
12. Draw springs and miscellaneous fasteners.			X	X	
13. Ink drawings of objects.	X	X	X	X	
14. Construct isometric drawings.	X	X		X	
15. Construct oblique drawings.	X			X	
16. Construct perspective mechanical drawing.			X	X	
17. Make a working detail drawing.	X	X	X	X	
18. Make assembly drawings.			X	X	
19. Graphically determine the true lengths and shapes of lines and planes.	X			X	
20. Graphically determine points and lines of intersection.	X	X		X	X

IV. BUILDING AND CONSTRUCTION

A. DRAFTING

JOB ENTRY TASKS	CODE 1	2	3	4	5
21. Lay out a pattern for a developed surface.				X	
22. Make a scale lay out piping drawing.	X	X		X	
23. Make a diagrammatic piping drawing.	X	X		X	
24. Draw block diagram.				X	
25. Draw a wiring diagram.	X		X	X	
26. Draw pictorial diagrams.	X		X	X	
27. Draw schematic diagram.			X	X	
28. Construct installation drawings.	X		X	X	
29. Draw architectural wiring and lighting plans.	X		X		
30. Draw supporting steel members and show connection details.	X			X	
31. Draw supporting concrete structures and reinforcement steel.	X			X	
32. Draw floor plans.	X			X	
33. Draw foundation plan.	X			X	
34. Draw elevations.		X			X
35. Organize schedules.	X	X	X	X	X
36. Draw sections and details.	X		X	X	
37. Draw plot plans.		X			X
38. Prepare architectural perspective drawings.	X				
39. Make topographical drawings.		X			X
40. Prepare technical illustrations.			X	X	
41. Construct drawings of cams, jigs, fixtures, and dies.				X	

IV. BUILDING AND CONSTRUCTION

A. DRAFTING

JOB ENTRY TASKS	CODE 1	2	3	4	5
42. Represent standard manufactured parts.	X	X	X	X	
43. Reproduce drawings.	X	X	X	X	
44. File tracings and prints.	X	X	X	X	
45. Receive and dispense information.	X	X	X	X	X
46. Perform necessary mathematical computation.	X	X	X	X	X
47. Use engineering tables.	X	X	X	X	X
48. Use surveying equipment.		X			X
49. Maintain harmonious relationships with coworkers, superiors, and subordinates.	X	X	X	X	X

IV. BUILDING AND CONSTRUCTION

B. ELECTRICAL

JOB ENTRY TASKS	CODE 1	2	3	4	5	6
1. Install new electrical systems.	X	X	X	X	X	X
2. Read blue prints and material lists.	X	X	X	X	X	X
3. Apply mathematical skills in measurement.	X	X	X	X	X	X
4. Install according to codes.	X	X				X
5. Test installation using appropriate equipment and procedures.	X	X			X	
6. Use available electrician's tools and equipment.	X	X				X
7. Identify common use hardware and equipment.	X	X	X	X	X	X
8. Utilize occupational skills to determine most economical and efficient materials and installation.	X	X	X	X		
9. Repair, replace, and maintenance of existing systems.	X	X		X		X
10. Trouble shoot problems with test equipment.	X	X		X		X
11. Use appropriate tools and equipment, disassemble and repair electrical equipment.	X	X				X
12. Replace defective parts or systems.	X	X				X
13. Perform routine preventive maintenance, including lubrication, painting, time scheduled replacement, etc.	X	X				X
14. Design and develop maintenance programs.	X	X		X		
15. Modify existing systems.	X	X	X	X		
16. Assess and recommend modernization.	X	X	X	X		
17. Assess and recommend changes to existing system.		X	X	X		
18. Assess and recommend needs for expansion of facilities.	X		X	X		

IV. BUILDING AND CONSTRUCTION

B. ELECTRICAL

JOB ENTRY TASKS	CODE 1	2	3	4	5	6
19. Call in consultants as required.	X	X	X	X		
20. Material and tool requisition.	X	X	X	X	X	X
21. Read prints and specifications.	X	X	X	X	X	X
22. Develop material, supply, tool, and equipment need list for job.	X	X	X	X		
23. Order job needs using approved practices.	X	X				
24. Estimate costs.			X	X		
25. Keep current on new developments in technology.	X	X	X	X		X
26. Maintain inventories on truck and shelf.	X	X				
27. Administration and records.	X	X	X	X	X	
28. Organize manpower needs for most efficient operations.	X	X			X	
29. Schedule equipment and materials for efficient use.	X	X				
30. Provide required data for cost accounting systems.	X	X	X	X		
31. Satisfy state and local insurance and bond standards.	X	X	X		X	
32. Physical health and safety.	X	X	X	X	X	X
33. Satisfy the physical requirements of the job.	X	X	X	X	X	X
34. Maintain personal health.	X	X	X	X	X	X
35. Reduce absenteeism to minimum.	X	X	X	X	X	X
36. Follow, practice safe procedures and practices.	X	X				X
37. Plan safety program for each job.	X	X				

IV. BUILDING AND CONSTRUCTION

B. ELECTRICAL

JOB ENTRY TASKS	DATE 1	2	3	4	5	6
38. Administer first aid including artificial respiration and heart massage.	X	X			X	X
39. Interpersonal relations.	X	X	X	X	X	X
40. Write clear and concise communications.	X	X	X	X	X	X
41. Orally communicate ideas and instructions.	X	X	X	X	X	X
42. Read instruction manuals, directions, and other written material for precise content.	X	X	X	X	X	X
43. Instruct and direct the activities of subordinates.	X	X				
44. Demonstrate effective relationships with customers and suppliers.	X		X	X		
45. Maintain effective relations with superiors and coworkers.	X	X	X	X	X	X
46. Work cooperatively with inspection personnel and engineers.	X	X	X	X	X	

IV. BUILDING AND CONSTRUCTION

C. MECHANICAL

JOB ENTRY TASKS	CODE 1	2	3	4
1. Use and care for common and specialized hand tools and power tools.	X	X	X	X
2. Use and care for general and specialized service equipment and installation equipment.	X	X	X	X
3. Use welding equipment to cut, weld, braze, and solder.	X	X	X	X
4. Use riveting, seaming, and other specialized metal working and shaping equipment.			X	
5. Install materials and equipment and evaluate the test results.	X	X	X	X
6. Install all types of piping, and equipment in accordance with national and local codes.	X	X		X
7. Install all types of ducting, and other thin metal parts in accordance with construction codes.			X	
8. Install special purpose piping systems.	X	X	X	X
9. Install valving of all types.	X	X		X
10. Install and test electrical control equipment.	X	X		X
11. Modify existing systems and installations.	X	X	X	X
12. Plan and install additions to existing systems and installations.	X	X	X	X
13. Read and use blueprints and material specifications.	X	X	X	X
14. Read and use electrical schematics, wiring diagrams, piping diagrams, and ducting diagrams.	X	X	X	X
15. Read and use plot drawings.	X	X		
16. Draw basic systems.	X	X	X	X
17. Develop material, supply, tool, and equipment lists for the job.	X	X	X	X

IV. BUILDING AND CONSTRUCTION

C. MECHANICAL

JOB ENTRY TASKS	CODE 1	2	3	4
18. Maintain adequate and economical inventories on truck and shelf.	X	X	X	X
19. Estimate costs, help prepare bid specifications.	X	X		
20. Order job needs using approved practices.	X	X	X	X
21. Schedule equipment and material for efficient use.	X	X	X	X
22. Organize manpower needs for most efficient operation.	X	X	X	X
23. Provide required data for cost accounting systems.	X	X	X	X
24. Satisfy the physical requirements of the job.	X	X	X	X
25. Plan a safety program for each job.	X	X	X	X
26. Follow safe practices and procedures.	X	X	X	X
27. Administer first aid.	X	X	X	X
28. Write clear and concise communications.	X	X	X	X
29. Orally communicate ideas and instructions.	X	X	X	X
30. Read instruction manuals, directions, and other material for precise content.	X	X	X	X
31. Instruct and direct the activities of subordinates.	X	X	X	X
32. Demonstrate effective relationships with customers and suppliers.	X	X	X	X
33. Maintain effective relations with superiors, coworkers, and union.	X	X	X	X
34. Work cooperatively with inspection personnel and engineers.	X	X	X	X

CHAPTER III

TASK - SKILLS/KNOWLEDGES ANALYSIS IN ENGINEERING AND INDUSTRIAL

This chapter presents the skills and/or knowledges for each task listed in Chapter II. The identification of these skills and knowledges was made utilizing the following resources:

1. Consultants with expertise in the appropriate area.
2. Area specialists from the Duval County School Board and Florida Junior College at Jacksonville.
3. Job Description information from various governmental agencies and businesses.
4. Publications on Engineering and Industrial careers.

A review of the skills and knowledges was made by members of the Advisory Committee before final approval. However, the skills and knowledges listed should not be considered as final. Each listing will be updated and revised as curriculum is developed in the second year of the project.

I. ELECTRO-MECHANICAL
A. ELECTRONICS

TASKS	SKILLS/KNOWLEDGES
1. Satisfy the physical requirements of the job.	1.1 Knowledge of the proper methods of lifting and handling equipment. 1.2 Has knowledge of personal strengths and weaknesses and has learned to compensate for the weaknesses. 1.3 Has developed specialized manipulative skills required in this work.
2. Follow, practice safe procedures and practices.	2.1 Knowledge of safe practices and procedures including inherent hazards and dangers to guard against. 2.2 Skill in working in a safe manner.
3. Use and care for common and specialized hand tools and power tools.	3.1 Identify the common and specialized hand and power tools used in the electronics field. 3.2 Select the proper tools for a given work assignment. 3.3 Know the capability of tools and proper usage. 3.4 Develops speed and facility in the use of hand tools. 3.5 Cleans, performs routine maintenance and replacement of worn parts.
4. Use proper soldering techniques.	4.1 Know what connections need to be soldered. 4.2 Know the types and characteristics of different solders.

I. ELECTRO-MECHANICAL
A. ELECTRONICS

TASKS	SKILLS/KNOWLEDGES
5. Read and interpret electronic symbols.	5.1 Knowledge of standard and special electronic symbols. 5.2 Knowledge of codes used in electronics work. 5.3 Skill in reading and interpreting electronic symbols.
6. Read and interpret electro-electronic schematic diagrams.	6.1 Know electrical fundamentals. 6.2 Know electronic fundamentals. 6.3 Knowledge of basic electrical and electronic circuits. 6.4 Knowledge of drafting practice. 6.5 Skill in applying knowledge of fundamentals to the interpretation of electrical, electronic schematics.
7. Read and interpret blueprints.	7.1 Knowledge of construction principles. 7.2 Knowledge of drafting practice. 7.3 Skill in basic drafting. 7.4 Skill in reading and interpreting blueprints.
8. Operate precision measuring test equipment.	8.1 Know electrical fundamentals. 8.2 Know electronic fundamentals. 8.3 Know and interpret electronic schematics.

TASKS	SKILLS/KNOWLEDGES
	8.4 Knowledge of test equipment available to the electronics technician.
	8.5 Knowledge of the total function of electronic equipment being tested.
	8.6 Knowledge of mathematics necessary to read and evaluate measurement results.
	8.7 Know how to calibrate test equipment.
	8.8 Know when test equipment is malfunctioning.
	8.9 Knowledge of how and where to hook up test equipment.
	8.10 Skill in operating test equipment for accurate readings and safe equipment operation.
9. Read color codes and markings on electronic components.	9.1 Knowledge of standard practice for color coding and marking.
	9.2 Skill in reading old and new component markings.
10. Design a basic electronic circuit.	10.1 Know the theory of electronics.
	10.2 Know the basics of circuit design.
	10.3 Know the equipment used in drawing and drafting.
	10.4 Know standard practice in drawing a schematic.
	10.5 Skill in drawing and labeling an electronic circuit.

TASKS	SKILLS/KNOWLEDGES
11. Construct a basic electronic circuit.	11.1 Knowledge of the required materials, tools, and equipment necessary for the job.
	11.2 Knowledge of the circuit design.
	11.3 Knowledge of the methods of construction.
	11.4 Skill in the use of hand and power tools.
	11.5 Skill in measurement.
	11.6 Skill in assembling, soldering, and circuit testing.
12. Modify circuits to meet changing situations.	12.1 Knowledge of specific electronic equipment and systems.
	12.2 Skill in determining changes that will improve performance.
	12.3 Skill in determining and recommending new or additional equipment for more efficient operations.
	12.4 Skill in the modification and checkout of existing circuits and systems.
13. Test and service electronic equipment.	13.1 Knowledge of basic physics of electricity, heat, and mechanics.
	13.2 Knowledge of mathematics including algebra, trigonometry, and calculus.
	13.3 Skill in applying physics and mathematics to testing and servicing electronic equipment.

I. ELECTRO-MECHANICAL
A. ELECTRONICS

TASKS	SKILLS/KNOWLEDGES
14. Trouble shoot an electronic device.	14.1 Knowledge of the device. 14.2 Knowledge of the problem involved. 14.3 Knowledge of test equipment. 14.4 Skill in isolating the circuit problem.
15. Read instruction manuals, directions, and other written material for precise content.	15.1 Know the language and terms of the industry. 15.2 Skill in reading technical writing, charts, graphs, statistical data, and other techniques of technical communication.
16. Analyze and interpret information obtained from precision measuring and recording equipment.	16.1 Knowledge of complex electronic devices, precision measuring and recording equipment. 16.2 Knowledge of problem or design change desired. 16.3 Knowledge of the intent of the electronic engineer. 16.4 Knowledge of the required mathematics. 16.5 Skill in analyzing and interpreting information.
17. Deal with a variety of technical problems involving many factors and variables.	17.1 Knowledge of electronics and electronic circuiting. 17.2 Knowledge of analytical processes and procedures. 17.3 Know the capabilities of the equipment and components.

TASKS	SKILLS/KNOWLEDGES
	17.4 Knowledge of test equipment and procedures.
	17.5 Skill in solving technical problems.
18. Repair or replace defective parts of systems in electronic devices.	18.1 Knowledge of the defective part or system.
	18.2 Knowledge of the economics of repair or replacement.
	18.3 Knowledge of the availability of replacements.
	18.4 Skill in repairing defective devices.
19. Plan, install and inspect the installation of complex equipment.	19.1 Knowledge of legal and safety requirements.
	19.2 Knowledge of equipment manufactured to accomplish the objective.
	19.3 Knowledge of installation procedures and practices.
	19.4 Knowledge of schematics and installation diagrams.
	19.5 Skill in handling and installing equipment.
20. Perform routine maintenance to maintain equipment efficiency.	20.1 Knowledge of maintenance schedules.
	20.2 Knowledge of time replacement systems.
	20.3 Knowledge of specific equipment.
	20.4 Knowledge of replacement methods of routine maintenance.
	20.5 Skill in routine maintenance.

TASKS	SKILLS/KNOWLEDGES
	20.6 Skill in determining efficiency of equipment.
21. Organize manpower needs for most efficient operations.	21.1 Know how to utilize helpers for most efficient work.
	21.2 Skill in organizing jobs so that minimum man hours are expended.
22. Develop material, supply, tool, and equipment list for the job.	22.1 Knowledge of plans, material specifications and job information to develop lists needed to complete work assignment.
23. Make technical evaluations and call consultants as required.	23.1 Knowledge of the requirements of the equipment.
	23.2 Knowledge of the capabilities of the equipment being evaluated.
	23.3 Know when the services of a consultant are required.
24. Keep current on new developments in technology.	24.1 Know where information on new developments is published, displayed, or demonstrated.
25. Prepare or interpret engineering drawings and sketches.	25.1 Knowledge of drafting.
	25.2 Knowledge of requirements of engineering drawings and sketches.
	25.3 Skill in preparing drawings and sketches.

I. ELECTRO-MECHANICAL
A. ELECTRONICS

TASKS	SKILLS/KNOWLEDGES
26. Advise, plan, and estimate costs of equipment and stock.	26.1 Knowledge of drafting interpretaion. 26.2 Knows the basics of good supply practice. 26.3 Knowledge of lead time for various supplies and equipment. 26.4 Knowledge of mathematics for estimators. 26.5 Skill in estimating costs of time and materials.
27. Administer first aid and abide by the 1971 Health and Safety Act.	27.1 Know the provisions of the Federal Health and Safety Act (1971). 27.2 Knowledge of safe practices and procedures including inherent hazards and dangers. 27.3 Skill in working in a safe manner. 27.4 Skill in applying first aid techniques.
28. Write clear and concise communications.	28.1 Knowledge of the language. 28.2 Knowledge of special words and terms associated with the industry. 28.3 Knowledge of good grammar and spelling. 28.4 Skill in technical writing techniques. 28.5 Skill in organizing thoughts and ideas for written communication.

I. ELECTRO-MECHANICAL
A. ELECTRONICS

TASKS	SKILLS/KNOWLEDGES
29. Communicate instructions and ideas orally.	29.1 Knowledge of the language and special terms. 29.2 Skill in oral communications. 29.3 Skill in questioning the communicant to determine proper understanding of ideas and instructions.
30. Demonstrate effective relations with customers and suppliers.	30.1 Skill in relations with people maintaining open and effective communications.
31. Maintain effective relations with superiors and coworkers.	31.1 Skill in getting along with other people. 31.2 Skill in selling ideas to superiors and coworkers.
32. Work cooperatively with inspection personnel and engineers.	32.1 Know the duties of inspectors and engineers. 32.2 Skill in relations with inspectors and engineers to promote harmonious relations.

CHAPTER III

TASK-SKILLS/KNOWLEDGES ANALYSIS

I-B. Electro-Mechanical

1. ELECTRO-MECHANICAL

B. Electro-Mechanical

TASKS	SKILLS/KNOWLEDGES
1. Satisfy the physical requirements of the job.	1.1 Knowledge of proper methods of lifting and handling of heavy material.
	1.2 Has knowledge of personal strengths and weaknesses, and has learned to compensate for the weaknesses.
	1.3 Has developed specialized manipulation skills required in this field.
2. Mathematically plan and analyze work.	2.1 Knowledge of mathematics, can include applied algebra, plain and analytical geometry, trigonometry and calculus.
	2.2 Skill in accurate computation.
	2.3 Skill in application of mathematics to problems, analysis, and design work associated with the electro-mechanical field.
3. Render technical assistance to craftsmen.	3.1 Knowledge of physics in the areas of mechanics, electricity, fluids, and pneumatics.
	3.2 Knowledge of associated mathematics.
	3.3 Knowledge of computers and uses.
	3.4 Knowledge of drafting.
	3.5 Knowledge of equipment and facilities.
	3.6 Skill in applying background knowledge to direct technical assistance.

TASKS	SKILLS/KNOWLEDGES
	3.7 Skill in the analysis of problems associated with the field.
4. Use properly the available hand and power tools associated with the electro-mechanical field.	4.1 Identify the common and specialized hand and power tools used in the electro-mechanical field. 4.2 Select the proper tools for a given work assignment. 4.3 Know the capabilities of tools and proper usage. 4.4 Develop speed and facility in the use of tools. 4.5 Cleans, performs routine maintenance and replacement of worn parts.
5. Use techniques of soldering, welding, and other skills associated with the field.	5.1 Knowledge of equipment used in welding, cutting, and different types of soldering. 5.2 Knowledge of equipment used in shaping and fabricating of metals, plastics, etc. 5.3 Knows the properties of different metals, and requirements for working them. 5.4 Skill in cutting, welding, machining, and other fabrication techniques.
6. Operate precision measuring and test equipment.	6.1 Knowledge of available precision measuring equipment including micrometers, dial indicators, guage blocks, etc., and their use.

TASKS	SKILLS/KNOWLEDGES
	6.2 Knowledge of test equipment including precision electrical, electronic, pressure gauges, Rockwell testers, and other types of equipment associated with the field.
	6.3 Skill in the use of precision measuring and test equipment.
	6.4 Perform maintenance within his capability.
7. Identify common use hardware and equipment.	7.1 Has knowledge of common use hardware and supplies.
	7.2 Has knowledge of equipment and machine tools, common to the field.
	7.3 Knowledge of the selection of appropriate hardware and equipment.
8. Interprets, analyzes and transmits facts and ideas graphically, orally, and in writing.	8.1 Knowledge of the language.
	8.2 Knowledge of special words and terms associated with the electro-mechanical field.
	8.3 Knowledge of good grammar and spelling.
	8.4 Skill in technical writing techniques.
	8.5 Skill in organizing thoughts and ideas for written communication.

TASKS	SKILLS/KNOWLEDGES
	8.7 Knowledge of drafting and photographic techniques.
	8.8 Skill in interpreting and analyzing data.
9. Prepares appropriate technical reports.	9.1 Skill in technical writing techniques.
	9.2 Knowledge of report forms and layout.
	9.3 Skill in preparing technical reports.
10. Read and interpret electro-mechanical blueprints, drawings, schematics, graphs, line diagrams, and bulletins.	10.1 Knowledge of basic drafting.
	10.2 Skill in reading blueprints, drawings, schematics, graphs, line diagrams, and bulletins.
	10.3 Skill in applying printed information to practice.
11. Selects, compiles and uses technical information from current references.	11.1 Knowledge of sources of technical information.
	11.2 Knowledge of where new developments are displayed or publicized.
	11.3 Knowledge of library and filing systems.
	11.4 Skill in selecting and locating necessary information.
	11.5 Skill in applying technical information to the completion of a job.

TASKS	SKILLS/KNOWLEDGES
12. Installs electro-mechanical equipment according to existing codes.	12.1 Knowledge of national and local codes.
	12.2 Knowledge of standard practice in installation of equipment.
	12.3 Skill in the installation of equipment in the phase of the field involved.
	12.4 Knowledge of the control systems used in specific equipment.
	12.5 Skill in the installation and hookup of control devices.
13. Determine the most economical and efficient materials and methods of installation.	13.1 Knowledge of materials for installation.
	13.2 Knowledge of methods of installation.
	13.3 Knowledge of mathematics to determine most economical installation.
	13.4 Skill in the application of materials, methods, and mathematics.
14. Test installations using the appropriate equipment and procedures.	14.1 Knowledge of various installations, electronic, electrical, mechanical, hydraulic, and pneumatic in nature.
	14.2 Knowledge of what is normal for various systems.
	14.3 Knowledge of the appropriate test and service equipment pertinent to its specific installation.
	14.4 Knowledge of testing procedures.

TASKS	SKILLS/KNOWLEDGES
	14.5 Skill in the use of test equipment.
	14.6 Skill in problem solving.
	14.7 Skill in locating defective parts of units.
15. Design and construct basic electro-mechanical systems.	15.1 Knowledge of basic electrical systems.
	15.2 Knowledge of basic electronic circuits.
	15.3 Knowledge of basic mechanical processes and systems.
	15.4 Knowledge of basic hydraulic systems.
	15.5 Knowledge of basic pneumatic systems.
	15.6 Skill in constructing elementary electrical and electronic circuits.
	15.7 Skill in construction of elementary mechanical, hydraulic and pneumatic systems.
16. Perform instrumental tests on mechanical, hydraulic, pneumatic, electrical or electronic components of industrial equipment.	16.1 Knowledge of basic systems.
	16.2 Knowledge of applicable test equipment.
	16.3 Knowledge of what components are expected to do.
	16.4 Knowledge of the total function of the equipment.
	16.5 Skill in performance tests.
	16.6 Skill in interpreting test data.

I. ELECTRO-MECHANICAL
B. ELECTRO-MECHANICS

TASKS	SKILLS/KNOWLEDGES
17. Using appropriate tools and equipment, disassembles and repairs electro-mechanical equipment.	17.1 Knowledge of system test results. 17.2 Knowledge of specific test results. 17.3 Knowledge of appropriate tools and equipment for repair job. 17.4 Skill in disassembling, repairing, and reassembling of component parts. 17.5 Skill in removing and replacing component parts and adjustments for satisfactory performance.
18. Replace defective parts or systems.	18.1 Knowledge of the parts of a given system. 18.2 Knowledge of which parts or system to replace. 18.3 Skill in removing and replacing component parts and systems, performing the necessary adjustments for operating efficiency.
19. Perform routine preventive maintenance on electro-mechanical equipment and develop appropriate maintenance programs to keep equipment operable and efficient.	19.1 Knowledge of specific equipment. 19.2 Knowledge of lubricants, hydraulic fluids, seals, etc., and their proper handling. 19.3 Knowledge of replacement methods of routine maintenance items. 19.4 Knowledge of methods of determining efficient operation. 19.5 Knowledge of manufacturers recommendations for service life.

TASKS	SKILLS/KNOWLEDGES
	19.6 Knowledge of maintenance requirements for extending life of equipment.
	19.7 Knowledge of maintenance scheduling systems.
	19.8 Skill in routine maintenance.
	19.9 Skill in developing time oriented maintenance schedules.
20. When required, recommends changes for improvement of existing systems.	20.1 Knowledge of specific electro-mechanical equipment and systems.
	20.2 Skill in determining changes that will improve performance.
	20.3 Skill in determining and recommending new or additional equipment for more efficient operations.
21. Assists in developing material, supply, tool and equipment needs for a job.	21.1 Use knowledge of plans, material specifications, and job information to develop lists needed to complete work assignment.
22. Assists in ordering job needs and estimating costs using approved practices.	22.1 Knowledge of blueprints, schematics, and codes.
	22.2 Knowledge of material lists.
	22.3 Knows the basics of good supply practice.
	22.4 Knowledge of lead time for various supplies and equipment.
	22.5 Knowledge of estimating practice.
	22.6 Knowledge of mathematics for estimators.

TASKS	SKILLS/KNOWLEDGES
	22.7 Skill in ordering job needs.
	22.8 Skill in estimating costs of time and materials.
23. Procide required data for cost accounting systems.	23.1 Knowldegd of accounting systems.
	23.2 Keep accurate records of time and materials by classification system in use.
24. Assists in maintaining inventory control.	24.1 Knowledge of inventory systems.
	24.2 Skill in posting perpetual inventory.
	24.3 Skill in establishing reorder control systems.
25. Schedules equipment and materials for efficient use.	25.1 Knowledge of equipment requirements.
	25.2 Plan equipment, material, and supply delivery for cost reduction.
	25.3 Skill in determining all material requirements so work is not delayed because of shortages.
26. Assists in planning production as a member of the management team.	26.1 Knowledge of production methods.
	26.2 Knowledge of production efficiency.
	26.3 Knowledge of current and new production equipment.
	26.4 Skill in planning for production.

TASKS	SKILLS/KNOWLEDGES
27. Establishes procedures for the most economical use of employees under his control.	27.1 Know how to utilize helpers for most efficient work. 27.2 Skill in organizing job so that minimum man hours are expended.
28. Keep fully informed of all safety precautions and proper procedures pertaining to his work.	28.1 Knowledge of safety equipment. 28.2 Knowledge of hazards of the job. 28.3 Knowledge of approved safety precautions, and safety procedures for a job. 28.4 Skill in working safely.
29. Plan a safety program for each job.	29.1 Know the provisions of the Federal Health and Safety Act. (1971) 29.2 Knowledge of safe practices and procedures including inherent hazards and dangers to guard against. 29.3 Skill in working in a safe manner. 29.4 Knowledge of planning a job for maximum safe conditions.
30. Administer first aid as required by federal act.	30.1 Knowledge of first aid procedures. 30.2 Skill in applying first aid techniques. 30.3 Knowledge of sources of first aid training for currency and upgrading.

TASKS	SKILLS/KNOWLEDGES
31. Demonstrate effecteve relationships with customers and suppliers.	31.1 Skill in relations with people, maintaining open and effective communications.
32. Maintain effective relations with superiors, coworkers, subordinates, inspection personnel, and engineers.	32.1 Knowledge of management and supervision techniques. 32.2 Knowledge of psychology and sociology pertaining to the management of subordinates. 32.3 Skill in communicating instructions so that the worker routinely accepts such direction. 32.4 Skill in getting along with other people. 32.5 Skill in selling ideas to superiors and coworkers.

CHAPTER III

TASK-SKILLS/KNOWLEDGES ANALYSIS

II. Climate Control

II. CLIMATE CONTROL

TASKS	SKILLS/KNOWLEDGES
1. Uses and cares for common and specialized hand tools and power tools.	1.1 Identify the common and specialized hand and power tools used in climate control and describe the general use of each.
	1.2 Select good tools.
	1.3 Select the proper tools for a job.
	1.4 Know the capabilities of tools and proper usage.
	1.5 Develop speed and facility in the use of tools.
	1.6 Cleans, performs routine maintenance, and replacement of worn parts.
2. Uses and cares for the general and specialized test equipment, service equipment and installation equipment.	2.1 Knows the equipment available to the technician.
	2.2 Knows the proper methods of using test, service, and installation equipment.
	2.3 Has developed facility and speed in use of equipment.
	2.4 Maintains equipment within his capability and knows when to send it to a specialist for repair.
3. Use welding equipment to cut, weld, braze, and solder.	3.1 Knowledge of equipment used in welding, cutting, and different types of soldering.
	3.2 Knows the properties of different materials to be joined.
	3.3 Knows the properties of different welding and soldering materials and fluxes.

TASKS	SKILLS/KNOWLEDGES
	3.4 Has developed skill in cutting, welding, brazing and soldering operations.
4. Satisfy the physical requirements of the job.	4.1 Knowledge of proper methods of lifting and handling of heavy material. 4.2 Has knowledge of personal strengths and weaknesses and has learned to compensate for the weaknesses. 4.3 Has developed specialized manipulative skills required in this work.
5. Maintain personal health.	5.1 Knowledge of personal physiology for maintenance of efficiency on the job.
6. Apply mathematical knowledge to measurement, installation of equipment and evaluation of test results.	6.1 Knowledge of mathematics including applied algebra, plain geometry, trigonometry, and analytical geometry. 6.2 Skill in application of mathematics to problems, analysis, and design work associated with climate control.
7. Install all types of air conditioning, refrigeration, heating and ventilating equipment in accordance with national and local codes.	7.1 Knowledge of national and local codes. 7.2 Knowledge of equipment manufactured for heating, cooling, and air transfer. 7.3 Basic knowledge of building design and construction. 7.4 Blueprint readin .

TASKS	SKILLS/KNOWLEDGES
	7.5 Knowledge of installation techniques.
	7.6 Skill in handling and installing equipment.
8. Utilize knowledge of refrigeration principles to test and service all types of installation.	8.1 Knowledge of refrigerants.
	8.2 Knowledge of basic refrigeration and air conditioning system.
	8.3 Knowledge of compressor and control systems.
	8.4 Knowledge of and skill in the use of test and service equipment for refrigeration cycle systems.
9. Utilize knowledge of electricity to connect, test, and service climate control equipment.	9.1 Knowledge of basic electricity and A/C circuits.
	9.2 Knowledge of electric motors and electric controls.
	9.3 Knowledge of national and local electric codes as applied to climate control equipment.
	9.4 Skill in the testing and diagnosis of electrical problems as related to motors and controls.
	9.5 Skill in the wiring and repair of electrical equipment used in climate control apparatus.
10. Utilize knowledge of refrigeration principles, heating system principles to test and service all types of installations.	10.1 Knowledge of reverse cycle systems, heat pumps, gas, and electrically energized refrigeration systems; gas, oil, coal, and electrically operated heating systems.
	10.2 Have skill in the testing and servicing of these systems.

II. CLIMATE CONTROL

TASKS	SKILLS/KNOWLEDGES
11. Plan and install duct systems for distribution of heating and cooling mediums.	11.1 Knowledge of heat transfer and volume of air to be moved including associated mathematics. 11.2 Know and use the fundamentals of drafting. 11.3 Read blueprints. 11.4 Have skill in the use and installation of duct and piping systems.
12. Compute heat gain and heat loss for commercial and residential buildings.	12.1 Knowledge of mathematics and engineering tables. 12.2 Accuracy in the computation of heat gain and loss.
13. Modify existing air conditioning, refrigeration, heating, and ventilating systems.	13.1 Compute additional requirements resulting from new equipment, additional floor area or other modifications.
14. Read and use plans and material specifications.	14.1 Knowledge of drafting practices and symbols. 14.2 Knowledge of material specification practices and materials in common use. 14.3 Skill in interpreting plans and material lists.
15. Read and use electrical schematics, wiring diagrams and piping diagrams.	15.1 Knowledge of electrical schematics, wiring diagrams, piping diagrams with associated symbols and notation. 15.2 Skill in the interpretation of engineering drawings.

TASKS	SKILLS/KNOWLEDGES
	15.3 Skill in transferring understanding of drawing to actual hookup of equipment.
16. Develop material, supply, tool and equipment requirement lists for the job.	16.1 Use knowledge of plans, material specifications and site information to develop lists of needs to complete a job.
17. Keep current on new developments in the technology.	17.1 Know where information on new developments is published, displayed and demonstrated.
18. Maintain inventories on truck and shelf.	18.1 Know the basics of good supply practice. 18.2 Have knowledge of lead time for various supplies and equipment.
19. Organize manpower needs for most efficient operations.	19.1 Know how to utilize helpers for most efficient work. 19.2 Skill in organizing job so that minimum man hours are expended.
20. Schedule equipment and materials for efficient use.	20.1 Use knowledge of heavy equipment requirements and job needs for maximum utilization of heavy equipment. 20.2 Plan equipment, material and supply delivery to minimize theft and damages. 20.3 Have knowledge of all material requirements so that work is not delayed because of shortages.

II. CLIMATE CONTROL

TASKS	SKILLS/KNOWLEDGES
21. Provide required data for cost accounting systems.	21.1 Knowledge of accounting systems. 21.2 Keep accurate records of time and materials by classification system in use.
22. Satisfy state and local insurance and bond standards.	22.1 Knowledge of laws and regulations applicable to the job. 22.2 Knowledge of contracts common to the industry.
23. Plan safety program for each job and follow safe practices and procedures.	23.1 Know the provisions of the Federal Health and Safety Act. (1971) 23.2 Knowledge of safe practices and procedures including inherent hazards and dangers to guard against. 23.3 Skill in working in a safe manner. 23.4 Knowledge of planning a job for maximum safe conditions.
24. Administer approved first aid as required.	24.1 Knowledge of first aid procedures. 24.2 Skill in applying first aid techniques. 24.3 Knowledge of sources of first aid training for currency and upgrading.
25. Write clear and concise communication.	25.1 Knowledge of the language. 25.2 Knowledge of special words and terms associated with the industry.

TASKS	SKILLS/KNOWLEDGES
	25.3 Knowledge of good grammar and spelling.
	25.4 Skill in technical writing techniques.
	25.5 Skill in organizing thoughts and ideas for written communication.
26. Orally communicate ideas and instructions.	26.1 Skill in oral communication.
	26.2 Skill in questioning the communicant to determine proper understanding of ideas and instructions.
27. Read instruction manuals, directions, and other written material for precise content.	27.1 Knowledge of the language and terms of the industry.
	27.2 Skill in reading technical writing, charts, graphs, statistical data, and other technical communication.
28. Instruct and direct activities of subordinates.	28.1 Knowledge of management and supervision techniques.
	28.2 Knowledge of psychology and sociology pertaining to the management of subordinates.
	28.3 Skill in communicating instructions so that the worker routinely accepts such direction.
29. Demonstrate effective relationships with customers and suppliers.	29.1 Skill in relations with people maintaining open and effective communications.

II. CLIMATE CONTROL

TASKS	SKILLS/KNOWLEDGES
30. Maintain effective relation with superiors and coworkers.	30.1 Skill in getting along with other people. 30.2 Skill in selling ideas to superiors and coworkers.
31. Work cooperatively with inspection personnel and engineers.	31.1 Knowledge of the duties and functions of inspectors and engineers. 31.2 Knowledge of the requirements of the installation as related to the inspectors and engineering personnel. 31.3 Skill in maintaining effective relationships with inspectors and engineers.

CHAPTER III

TASK-SKILLS/KNOWLEDGES ANALYSIS

III. Transportation

III. TRANSPORTATION

TASKS	SKILLS/KNOWLEDGES
1. Satisfy the physical requirements of the job.	1.1 Knowledge of proper methods of lifting and handling of heavy material.
	1.2 Has knowledge of personal strengths and weaknesses and has learned to compensate for the weaknesses.
	1.3 Has developed specialized manipulative skills required in this work.
2. Follow safe practices and procedures.	2.1 Knowledge of safe practices and procedures including inherent hazards and dangers to guard against.
	2.2 Skill in working in a safe manner.
3. Satisfy local, state, and national legal requirements.	3.1 Knowledge of the legal requirements and inplication of the work.
	3.2 Knowledge of the licensing requirements of the job.
	3.3 Knowledge necessary to obtain licenses.
	3.4 Skill necessary to obtain licenses.
4. Operate the equipment in a safe and efficient manner.	4.1 Knowledge of the operating characteristics of the equipment being operated.
	4.2 Knowledge of the inherent hazards of the equipment.
	4.3 Knowledge of hazards associated with malfunctions.

TASKS	SKILLS/KNOWLEDGES
	4.4 Skill in operating all or part of the equipment.
	4.5 Skill in avoiding potential hazards of equipment operation.
	4.6 Skill in operating equipment in a manner that will prevent equipment damage.
5. Use and care for common and specialized hand and power tools.	5.1 Identify the common and specialized hand and power tools used in the transportation field and describe the general use of each.
	5.2 Select good tools.
	5.3 Select the proper tools for a job.
	5.4 Know the capabilities of tools and proper usage.
	5.5 Develop speed and facility in the use of tools.
	5.6 Cleans, performs routine maintenance, and replacement of worn parts.
6. Use and care for test, maintenance and overhaul equipment.	6.1 Knows the equipment available to the technician.
	6.2 Knows the use and care of electrical, hydraulic, and mechanical test equipment.
	6.3 Knows the use and care of maintenance equipment including compressors, lifts, jacks, cleaning and lubrication equipment, etc.

TASKS	SKILLS/KNOWLEDGES
	6.4 Knows the use and care of overhaul equipment including boring bars, valve grinders, drills, bench grinders, presses, etc.
	6.5 Has developed facility and speed in the use of equipment.
	6.6 Maintains equipment within his capability and knows when to send it to a specialist for repair.
7. Apply mathematical knowledge to measuring, computing, and problem solving.	7.1 Knowledge of mathematics including business arithmetic, solving algebraic formulas, fractions, decimals, and elementary geometry.
	7.2 Skill in application of mathematics to measurement, computing and problem solving.
8. Apply the knowledge of physics and chemistry to understanding machines and correcting problems.	8.1 Knowledge of physics concerning heat, simple machines, hydraulics, and electricity.
	8.2 Knowledge of chemistry related to combustion, electro-chemical reactions, and air pollution.
	8.3 Skill in the application of related physics and chemistry to problems in the transportation industry.
9. Use welding equipment.	9.1 Knowledge of equipment used in welding, heating, cutting, and different types of soldering.
	9.2 Know the effects of heat on different types of materials.

TASKS	SKILLS/KNOWLEDGES
	9.3 Skill in the use of heating equipment for welding, cutting, heating, and soldering.
10. Read and interpret drawings, schematics, piping drawings, exploded views, and pictorial representations.	10.1 Knowledge of drafting principles. 10.2 Knowledge of the methods of transmitting information other than in writing. 10.3 Skill in the use of drawings, electrical schematics, drawings, and pictorial views.
11. Use plot plans and surveyors' grade stakes.	11.1 Knowledge of drafting principles. 11.2 Knowledge of surveying principles. 11.3 Knowledge of surveying practice. 11.4 Skill in interpreting plot plans and surveyors' cut, fill, grade and location marks.
12. Repair conventional gasoline engines and associated equipment.	12.1 Knowledge of basic engine construction and repair. 12.2 Knowledge of fuel, lubrication, cooling, ignition, and electrical systems. 12.3 Skill in the diagnosis, and repair, of problems associated with the conventional gasoline engine.
13. Repair diesel engines and associated equipment.	13.1 Knowledge of basic engine construction. 13.2 Knowledge of fuel, lubrication, cooling, starting, and electrical systems.

TASKS	SKILLS/KNOWLEDGES
	13.3 Skill in the diagnosis and repair of problems associated with the conventional diesel engine.
14. Repair turbine engines and associated systems.	14.1 Knowledge of basic engine construction.
	14.2 Knowledge of fuel, lubrication and ignition systems and associated equipment.
	14.3 Skill in diagnosing problems.
	14.4 Skill in repair or referral of problems.
15. Repair power transmission equipment.	15.1 Knowledge of clutches, torque converters, gears, and bearings.
	15.2 Knowledge of hydraulics, and mechanical power transmission principles.
	15.3 Skill in diagnosis and repair of power transmission equipment.
16. Repair steering, control, and suspension systems.	16.1 Knowledge of steering and steering geometry.
	16.2 Knowledge of braking system.
	16.3 Knowledge of suspension system.
	16.4 Knowledge of electrical, pneumatic, and hydraulic principles.
	16.5 Skill in the repair and testing of steering, brake, and suspension systems.

TASKS	SKILLS/KNOWLEDGES
17. Straighten and align metal parts.	17.1 Knowledge of the methods and procedures of straightening and aligning metal parts.
	17.2 Skill in efficiently straightening and aligning parts.
18. Apply protective coatings and paints.	18.1 Knowledge of methods and procedures for preparation of the base.
	18.2 Knowledge of types of protective coats including plating, painting, anodizing, and corrosion preventive materials.
	18.3 Knowledge of preparation of protective coatings and paints.
	18.4 Skill in proparation of base, mixing, matching, and application of protective and decorative materials.
19. Install and service accessory equipment.	19.1 Knowledge of available accessory equipment such as airconditioning, power assist and take-off equipment, crane extensions and other equipment according to the area of specialization.
	19.2 Skill in the installation and servicing of accessory equipment.
20. Examine equipment and parts for wear and adjustment recommending corrective procedures.	20.1 Knowledge of precision test and measurement equipment.
	20.2 Knowledge of the sources of specifications.

TASKS	SKILLS/KNOWLEDGES
	20.3 Knowledge of adjusting procedures.
	20.4 Skill in measuring and testing.
	20.5 Skill in repair and adjusting machinery.
21. Conduct routine in-service inspections and keep records of data obtained.	21.1 Knowledge of routine inspection requirements.
	21.2 Knowledge of data required and records systems.
	21.3 Skill in performing inspections and recording data.
22. Develop material, supply, tool and equipment requirement lists for a job.	22.1 Knowledge of necessary materials, supplies, tools, and equipment to complete a repair job or assignment.
	22.2 Skill in the selection of the proper tools, materials, and supplies, and equipment.
23. Keep current on new developments in the technology.	23.1 Know where information on new developments is published, displayed and demonstrated.
24. Maintain parts inventory.	24.1 Know the principles of supply.
	24.2 Knowledge of efficient stock levels.
	24.3 Know the lead time for different stock.
	24.4 Skill in maintaining parts for ready access and use.

III. TRANSPORTATION

TASKS	SKILLS/KNOWLEDGES
25. Organize manpower needs for most efficient operations.	25.1 Know how to utilize helpers for most efficient work.
	25.2 Skill in organizing jobs so that minimum man hours are expended.
26. Plan a safety program and implementation.	26.1 Know the provisions of the Federal Health and Safety Act. (1971)
	26.2 Knowledge of planning a job for maximum safe conditions.
27. Administer first aid as required.	27.1 Knowledge of first aid procedures.
	27.2 Skill in applying first aid techniques.
	27.3 Knowledge of sources of first aid training for currency and upgrading.
28. Write clear, and concise communications.	28.1 Knowledge of the language.
	28.2 Knowledge of special words and terms associated with the industry.
	28.3 Knowledge of good grammar and spelling.
	28.4 Skill in technical writing techniques.
	28.5 Skill in organizing thoughts and ideas for written communication.

III. TRANSPORTATION

TASKS	SKILLS/KNOWLEDGES
29. Orally communicate ideas and instructions.	29.1 Knowledge of the language and special terms. 29.2 Skill in oral communication. 29.3 Skill in questioning the communicant to determine proper understanding of ideas and instructions.
30. Read instruction manuals, directions and other written material for precise content.	30.1 Knowledge of the language and terms of the industry. 30.2 Skill in reading technical writing, charts, graphs, statistical data, and other techniques of technical communication.
31. Demonstrate effective relationships with customers and suppliers.	31.1 Skill in relations with people maintaining open and effective communications.
32. Maintain effective relationship with superiors, coworkers, and subordinates.	32.1 Knowledge of management and supervision techniques. 32.2 Knowledge of psychology and sociology pertaining to the management of subordinates. 32.3 Skill in communicating instructions so that the worker routinely accepts such directions. 32.4 Skill in getting along with other people. 32.5 Skill in selling ideas to superiors and coworkers.
33. Work cooperatively with inspection personnel and engineers.	33.1 Knowledge of the duties and functions of inspectors and engineers.

TASKS	SKILLS/KNOWLEDGES
	33.2 Knowledge of the requirements of the installation as related to the inspectors and engineering personnel.
	33.3 Skill in maintaining effective relationships with inspectors and engineers.

CHAPTER III

TASK-SKILLS/KNOWLEDGES ANALYSIS

IV-A. Drafting

IV. BUILDING AND CONSTRUCTION
A. DRAFTING

TASKS	SKILLS/KNOWLEDGES
1. Uses and cares for instruments and equipment, including all types of measurement devices.	1.1 Knows the function of the tools and equipment associated with drafting work. 1.2 Skill in the use of drafting tools and equipment. 1.3 Knows scales and other types of measurement devices. 1.4 Knows mathematics including arithmetic, algebra, and analytic geometry. 1.5 Has a high degree of skill and accuracy in the use of mathematics.
2. Letters, dimensions, and notes on drawings.	2.1 Knowledge of styles of lettering. 2.2 Skill in drawing letters, numerals, and fractions using approved style. 2.3 Knowledge of the principles and cperation of lettering devices.
3. Constructs gecmetric figures.	3.1 Knowledge of the principles of geometric constructions. 3.2 Skill in the use of drafting instruments.
4. Constructs multiview drawings using the system of orthographic projection.	4.1 Knowledge of the theory of orthographic projection. 4.2 Skill in determining the planes of projection. 4.3 Knowledge of showing hidden features, precedence of lines, normal, oblique, inclined, and cylindrical surfaces.

IV. BUILDING AND CONSTRUCTION
A. DRAFTING

TASKS	SKILLS/KNOWLEDGES
	4.4 Knowledge of drawing runouts and filleted intersections.
5. Dimensions drawings.	5.1 Knowledge of dimensioning practice. 5.2 Skill in properly dimensioning drawings.
6. Make orthographic or pictorial freehand sketches.	6.1 Know the techniques or methods and materials for sketching. 6.2 Have skill in sketching.
7,8,9. Constructs sectional, primary, and secondary auxiliary views.	7,8,9.1 Knowledge of methods of construction of sectional, primary, and suxiliary views. 7,8,9.2 Skill in the choice and drawing of the best sectional, primary, and auxiliary views.
10,11,12. Draw threaded fasteners, permanent fasteners, welding symbols, springs and miscellaneous fasteners.	10,11,12.1 Knowledge of catalogs, engineering tables and guages. 10,11,12.2 Knowledge of common methods of fastening materials. 10,11,12.3 Know characteristics and uses of nails, wood screws, rivets, and other fasteners, being able to locate and specify best usage. 10,11,12.4 Have a basic knowledge of welding processes, uses, and drawing of appropriate symbols. 10,11,12.5 Have skill in drawing accurate representations symbols.

IV. BUILDING AND CONSTRUCTION
A. DRAFTING

TASKS	SKILLS/KNOWLEDGES
13. Ink drawings of objects.	13.1 Know the methods of inking drawings. 13.2 Use inking instruments, brushes, and mechanical lettering devices.
14. Construct isometric drawings.	14.1 Know the use of specialized equipment and materials. 14.2 Know the theory of isometric drawing. 14.3 Be able to represent an object in pictorial form.
15. Construct oblique drawings.	15.1 Know the theory of oblique projection. 15.2 Develops skill and accuracy in the use of the oblique method.
16. Construct perspective mechanical drawing.	16.1 Know the theory and special techniques of perspective projection. 16.2 Be able to construct one and two point perspective drawings.
17. Make a working detail drawing.	17.1 Knowledge of measuring instruments. 17.2 Knowledge of manufacturing processes. 17.3 Knows the necessary views, dimensions, and notes necessary for construction or manufacture. 17.4 Skill in making a working drawing so it can be manufactured by a competent craftsman.

TASKS	SKILLS/KNOWLEDGES
18. Make assembly drawings.	18.1 Knows how to draw orthographic and pictorial projections. 18.2 Knowledge of manufacturers' catalogs, conventions, dimension techniques, and specifications. 18.3 Skill in drawings of an assembly so it can be assembled by a competent craftsman.
19-20. Graphically determine the true lengths, shapes of lines and planes, determine points and lines of intersection.	19-20.1 Know the principles of projection and descriptive geometry. 19-20.2 Accuracy in the use of instruments.
21. Lay out a pattern for a developed surface.	21.1 Principles of descriptive geometry, triangulation, and rotating techniques. 21.2 Skill in the use of mathematics and drafting tools to draw a pattern.
22. Make a scale layout piping drawing.	22.1 Know sizes and types of pipe, valves, and fittings. 22.2 Know types of joints and threads. 22.3 Compute proper size and fitting for a given piping system. 22.4 Draw an accurate layout including dimensioning specifications and notes.
23-24. Make a diagrammatic block and piping drawing.	23-24.1 Knowledge of engineering specifications.

TASKS	SKILLS/KNOWLEDGES
	23-24.2 Knowledge of plumbing fundamentals and drafting symbols.
	23-24.3 Skill in drawing workable piping systems.
25. Draw a wiring diagram.	25.1 Basic and advanced knowledge of electricity.
	25.2 Knowledge of electrical symbols and notations.
	25.3 Knowledge of accepted industry standards, for methods of wiring civil and architectural projects.
	25.4 Know the electric wiring codes.
	25.5 Use electrical math to determine proper specifications.
	25.6 Skill in developing wiring diagrams.
26-27. Draw schematic and pictorial diagrams.	26-27.1 Know the fundamentals of electro-electronics.
	26-27.2 Know the layout and symbols for drawing electro-electronic schematics.
	26-27.3 Know the methods of development of pictorial diagram.
	26-27.4 Know the mathematics for electronic design.
	26-27.5 Skill in applying knowledge to check drawings against desired results.
28. Construct installation drawings.	28.1 Know the fundamentals of construction practice.

TASKS	SKILLS/KNOWLEDGES
	28.2 Know the codes related to construction and installation of equipment.
	28.3 Draw all required drawings for electro-electronic equipment installation using appropriate symbols and notation.
29. Draw architectural wiring and lighting plan.	29.1 Knowledge of architectural drawing and symbols.
	29.2 Knowledge of industry wiring and lighting standards.
	29.3 Knowledge of types of lighting.
	29.4 Apply electro-electronic knowledge to design of plan.
	29.5 Skill in constructing architectural wiring and lighting plans.
30. Draw supporting steel members and show connection details.	30.1 Know structural terminology and theory.
	30.2 Know mathematics associated with strength of materials and use of structural steel handbooks.
	30.3 Interpret engineering notes.
	30.4 Know structural dimensioning.
	30.5 Draw details of supporting steel members and their connections.
31. Draw supporting concrete structures and reinforced steel.	31.1 Know the related mathematics.

TASKS	SKILLS/KNOWLEDGES
	31.2 Know the terminology and related theory of reinforced steel.
	31.3 Use engineering handbooks.
	31.4 Interpret engineering notes.
	31.5 Skill in drawing details of prestressed, cast-in-place, pilings, "I" beams, slabs, and specifying reinforcement steel.
32. Draw floor plans.	32.1 Know the codes applicable to the building and construction trade.
	32.2 Know the fundamentals of design and practice in the building trades.
	32.3 Know the use of catalogs and design notes.
	32.4 Know conventions and symbols for drawings.
	32.5 Skill in drawing a floor plan including exterior and interior walls, location of doors, windows, stairs, etc., and complete drawings with all dimensions, symbols, and notes.
33. Draw a foundation plan.	33.1 Know building codes and construction methods.
	33.2 Skill in the development of plans for slab-on-grade, pier, and column foundations.
34. Draw elevations.	34.1 Knowledge of architectural drafting procedures and techniques.

TASKS	SKILLS/KNOWLEDGES
	34.2 Use of catalogs and reference materials.
	34.3 Knowledge of construction methods.
	34.4 Skill in drawing roof, windows, and other details, adding all required dimensions and notes.
35. Organize schedules.	35.1 Have knowledge of construction materials and specifications.
	35.2 Skill in the use of manufacturers' catalogs and reference materials.
	35.3 Fill in window, door, and finish schedules.
36. Draw sections and details.	36.1 Knowledge of construction details, conventional symbols and practices.
	36.2 Skill in drawing wall sections, construction cross-section, and details for stairs, cabinets, etc.
37. Draw plot plans.	37.1 Know the fundamentals of surveying.
	37.2 Read surveyor's notes.
	37.3 Use mathematics to check surveyor's reductions.
	37.4 Know standard plot symbols and conventions and dimensioning techniques.
	37.5 Know building codes.

IV. BUILDING AND CONSTRUCTION
A. DRAFTING

TASKS	SKILLS/KNOWLEDGES
	37.6 Have skill in drawing plot plans including locating utilities, streets, drives, finish grades and building locations.
38. Prepare architectural perspective drawings.	38.1 Know the theory of perspective drawing. 38.2 Know the specialized equipment used. 38.3 Have skill in making a two-point perspective drawing.
39. Make topographical drawings.	39.1 Know the fundamentals of surveying. 39.2 Know the use and limits of survey instruments. 39.3 Know trigonometry. 39.4 Skill in making a topographical drawing from surveying notes.
40. Prepare technical illustrations.	40.1 Know illustration drawing techniques. 40.2 Use of drawing media. 40.3 Use of paste-up media. 40.4 Know camera and printing techniques. 40.5 Skill in the preparation of technical illustrations for reproduction.
41. Construct drawings of cams, gears, jigs, fixtures, and dies.	41.1 Knowledge of basic physics of mechanics.

TASKS	SKILLS/KNOWLEDGES
	41.2 Know and be able to apply mathematics to the design of mechanical parts.
	41.3 Know manufacturing methods and tools.
	41.4 Use reference materials.
	41.5 Skill in the design and development of drawings of mechanical parts.
42. Represent standard manufactured parts.	42.1 Know how to use manufacturers' catalogs and reference material.
	42.2 Draw standard parts specified in manufacturers' catalogs.
43. Reproduces drawings.	43.1 Knowledge of reproduction media and processes.
	43.2 Skill in the use of reproduction equipment.
44. File tracings and prints.	44.1 Knowledge of efficient filing systems and storage facilities.
45. Receive and disperse information.	45.1 Knowledge of drafting room procedures.
	45.2 Know where information on new developments is published, displayed or demonstrated.
	45.3 Knowledge of the language.
	45.4 Knowledge of special words and terms associated with the field.

TASKS	SKILLS/KNOWLEDGES
	45.5 Knowledge of good grammar and spelling.
	45.6 Skill in technical writing techniques.
	45.7 Skill in organizing thoughts and ideas for written communication.
	45.8 Skill in relations with people, maintaining open and effective communications.
46. Perform necessary mathematical computation.	46.1 Knowledge of mathematical theory.
	46.2 Knowledge of mathematical tools, including slide rules, calculators, computers.
	46.3 Skill in the determination of methods of arriving at necessary mathematical information.
47. Use engineering tables.	47.1 Knowledge of the location and use of engineering charts and tables.
	47.2 Skill in the selection of the proper table.
	47.3 Skill in the use of charts, tables, scales, etc.
48. Use surveying equipment.	48.1 Knowledge of common and special use surveying equipment.
	48.2 Knowledge of aides to surveyors, bench marks, existing surveys, etc.
	48.3 Knowledge of the needs of the draftsman.

TASKS	SKILLS/KNOWLEDGES
	48.4 Knowledge of the mathematics of surveying.
	48.5 Knowledge of the practices and procedures of surveying.
	48.6 Know the organization of the survey party and duties of each member.
	48.7 Skill and accuracy in completing the survey project.
49. Maintain harmonious relationships with coworkers, superiors, and subordinates.	49.1 Know the function and duties of associates.
	49.2 Know his duties as related to associates.
	49.3 Skill in maintaining effective relationships with coworkers, engineers, field personnel and superiors.

CHAPTER III

TASK-SKILLS/KNOWLEDGES ANALYSIS

IV-B. Electrical

IV. BUILDING AND CONSTRUCTION
B. ELECTRICAL

TASKS	SKILLS/KNOWLEDGES
1. Install new electrical systems.	1.1 Knowledge of drafting practices and symbols.
	1.2 Knowledge of material specifications, practices, and electrical materials in common use.
	1.3 Skill in interpreting plans and material lists.
	1.4 Knowledge of electrical schematics, wiring diagrams with associated symbols and notations.
	1.5 Skill in the interpretation of engineering drawings.
	1.6 Skill in transferring drawing interpretations to actual installation of equipment.
	1.7 Knowledge and application of mathematics skills including elements of algebra, geometry, and trigonometry associated with the electrical industry.
	1.8 Knowledge of national and local codes and standards.
	1.9 Knowledge of the available test and measurement equipment.
	1.10 Skill in the use of test and measurement equipment.
	1.11 Knowledge of the theory of electrical circuits and systems.
	1.12 Skill in the testing of installations to determine proper operation.
	1.13 Know the common and specialized hand and power tools used in the electrical industry.

TASKS	SKILLS/KNOWLEDGES
	1.14 Select the proper tools for a job.
	1.15 Know the capabilities of tools and proper usage.
	1.16 Develop speed and facility in the use of tools.
	1.17 Cleans, performs routine maintenance and replacement of worn parts in tools and equipment.
	1.18 Identify and know the uses of hardware and equipment common to the electrical business.
	1.19 Utilize occupational skills to determine the most economical and efficient materials and installation.
2. Repair, replacement, and maintenance of existing systems.	2.1 Knowledge of basic alternating current and direct circuits.
	2.2 Skill in the application of basic theory to existing equipment to determine problems.
	2.3 Skill in the use of appropriate tools and equipment to disassemble and repair electrical equipment.
	2.4 Knowledge of motors, controls, and other electrical apparatus.
	2.5 Knowledge of and the ability to replace defective parts or systems.
	2.6 Knowledge of routine preventive maintenance.
	2.7 Knowledge of lubricants.

TASKS	SKILLS/KNOWLEDGES
	2.8 Knowledge of paint and paint procedures.
	2.9 Skill in the performance of maintenance and time scheduled replacement.
	2.10 Knowledge of the methods of design and development of maintenance programs.
3. Modify existing systems.	3.1 Keep current on new developments in the technology. Krow where information is published, displayed, and demonstrated.
	3.2 Compute additional requirements resulting from new equipment, floor area or other modifications.
	3.3 Knowledge of the limitations of the technicians and when to call in consultants.
4. Material and tool requisition.	4.1 Knowledge of schematics, blueprints, and specifications.
	4.2 Skill in develcping material, supply, tool and equipment need list for a job.
	4.3 Knowledge of material specification practices and materials in common use.
	4.4 Plan equipment, material and supply delivery to minimize theft and damages.
	4.5 Knowledge of accounting systems.
	4.6 Knowledge of current costs of equipment, supplies and manpower.

TASKS	SKILLS/KNOWLEDGES
	4.7 Knowledge of new developments of equipment and methods.
	4.8 Skill in the development of cost estimates.
	4.9 Knowledge of material requirements for shelf and truck supply levels.
5. Administration and records.	5.1 Know how to utilize helpers for most efficient work.
	5.2 Skill in organizing job so that minimum man hours are expended.
	5.3 Use knowledge of specialized work equipment requirements and job needs for maximum utiliaztion of special equipment.
	5.4 Plan equipment material and supply delivery to minimize theft and damages.
	5.5 Have knowledge of all material requirements so work is not delayed because of shortages.
	5.6 Knowledge of accounting systems.
	5.7 Keep accurate records of time and materials by classification system in use.
	5.8 Knowledge of laws and regulations applicable to the job.
	5.9 Knowledge of contracts common to the industry.

TASKS	SKILLS/KNOWLEDGES
6. Physical health and safety.	6.1 Know the provisions of the Federal Health and Safety Act (1971).
	6.2 Knowledge of safe practices and procedures including inherent hazards and dangers to guard against.
	6.3 Skill in working in a safe manner.
	6.4 Knowledge of planning a job for maximum safe conditions.
	6.5 Knowledge of first aid procedures.
	6.6 Skill in applying first aid techniques.
	6.7 Knowledge of sources of first aid training for currency and upgrading.
	6.8 Knowledge of personal physiology for maintenance of efficiency on the job.
7. Intrapersonal relations.	7.1 Knowledge of the language.
	7.2 Knowledge of special words and terms associated with the industry.
	7.3 Knowledge of good grammar and spelling.
	7.4 Skill in technical writing techniques.
	7.5 Skill in organizing thoughts and ideas for written communication.
	7.6 Skill in oral communication.

TASKS	SKILLS/KNOWLEDGES
	7.7 Skill in questioning the communicant to determine complete understanding of ideas and instructions.
	7.8 Skill in reading technical writing, charts, graphs, schematics and other techniques of technical communication.
	7.9 Knowledge of management and supervision techniques.
	7.10 Knowledge of psychology and sociology pertaining to the management of subordinates.
	7.11 Skill in communication instructions so that the worker routinely accepts such directions.
	7.12 Skill in relations with people maintaining open and effective communication.
	7.13 Skill in getting along with other people.
	7.14 Skill in selling ideas to superiors and co-workers.
	7.15 Knowledge of the duties and functions of inspectors and engineers.
	7.16 Knowledge of the requirements of the job as related to the inspectors and engineering personnel.
	7.17 Skill in maintaining effective relationships with superiors, customers, inspectors and engineers.

CHAPTER III

TASK-SKILLS/KNOWLEDGES ANALYSIS

IV-C. Mechanical

IV. BUILDING AND CONSTRUCTION
C. MECHANICAL

TASKS	SKILLS/KNOWLEDGES
1. Use and care for common and specialized hand tools and power tools.	1.1 Identify the common and specialized hand and power tools used in the mechanical field and know the general use of each. 1.2 Select good tools. 1.3 Select the proper tools for a job. 1.4 Know the capabilities of tools and proper usage. 1.5 Develop speed and facility in the use of tools. 1.6 Cleans, performs routine maintenance, and replacement of worn parts.
2. Uses and cares for general and specialized service equipment and installation equipment.	2.1 Knows the equipment available to the technician. 2.2 Know the proper methods of using service and installation equipment. 2.3 Has developed facility and speed in the use of equipment. 2.4 Maintains equipment within his capability, and knows when to send it to a specialist for repair.
3. Use welding equipment to cut, weld, braze, and solder.	3.1 Knowledge of equipment used in welding, cutting, and different types of soldering. 3.2 Knows the properties of different materials to be joined.

TASKS	SKILLS/KNOWLEDGES
	3.3 Knows the properties of different welding and soldering materials and fluxes.
	3.4 Has developed skill in cutting, welding, brazing and soldering operations.
4. Use riveting, seaming, and other specialized metal working equipment.	4.1 Knowledge of the equipment available to the sheet metal trade.
	4.2 Knowledge of the methods of cutting, shaping, and fastening sheet metal.
5. Install materials and equipment and evaluate the results.	5.1 Knowledge of mathematics including algebra, and trigonometry.
	5.2 Skill in application of mathematics to problems, analysis and design work associated with piping and sheet metal.
	5.3 Knowledge of test equipment and mathematical analysis of test results.
6. Install all types of piping and equipment in accordance with material and local codes.	6.1 Knowledge of national and local codes.
	6.2 Skill in the installation of piping and equipment according to code.
7. Install all types of ducting and other thin metal parts in accordance with construction codes.	7.1 Knowledge of the use of ducting, flashing moldings, etc., in accordance with codes.
	7.2 Skill in the use of ducting, flashing moldings, etc.

TASKS	SKILLS/KNOWLEDGES
8. Install special purpose piping systems.	8.1 Knowledge of physics and chemistry associated with piping and sheet metal work. 8.2 Skill in the application of physics and chemistry associated with the effects of adverse chemical and mechanical conditions. 8.3 Skill in the application of safe practices to hazardous materials and conditions.
9. Install valving of all types.	9.1 Knowledge of types of valves available to the industry. 9.2 Knowledge of valving control systems and auxiliary equipment. 9.3 Skill in the installation of valving and controls.
10. Install and test electrical control equipment.	10.1 Knowledge of basic electricity. 10.2 Knowledge of electro-mechanical equipment common to the industry. 10.3 Knowledge of electrical test equipment. 10.4 Skill in the installation and test of electric control equipment.
11. Modify existing systems and installations.	11.1 Knowledge of additional requirements resulting from new equipment or changes in processes. 11.2 Skill in determining the most efficient methods of modifying existing systems.

IV. BUILDING AND CONSTRUCTION
C. MECHANICAL

TASKS	SKILLS/KNOWLEDGES
12. Plan and install additions to existing systems and installations.	12.1 Knowledge of common practice for additions to existing systems and installations. 12.2 Skill in installing additional plumbing, piping, and ducting.
13. Read and use blueprints and material specifications.	13.1 Knowledge of drafting practices and symbols. 13.2 Knowledge of material specification practices and materials in common use. 13.3 Skill in interpreting plans and material lists.
14. Read and use electrical schematics, wiring diagrams, piping diagrams, and ducting diagrams.	14.1 Knowledge of electrical schematics, wiring diagrams, piping diagrams with associated symbols and notation. 14.2 Skill in the interpretation of engineering drawings. 14.3 Skill in transferring understanding of drawing to actual hookup of equipment.
15. Read and use plot plans.	15.1 Knowledge of surveyor's practices. 15.2 Know[illegible] of plot drafting practice. 15.3 Skill in interpreting plot plans, and applying installation of below grade piping systems.
16. Draw basic systems.	16.1 Know drafting equipment and practice.

TASKS	SKILLS/KNOWLEDGES
	16.2 Basic skill in drafting of schematics, piping diagrams and drawings.
17. Develop material, supply, tool, and equipment lists for the job.	17.1 Use knowledge of plans, material specifications and site information to develop lists of needs to complete a job.
18. Maintain adequate and economical inventories on truck and shelf.	18.1 Know the basics of good supply practice. 18.2 Have knowledge of lead time for various supplies and equipment.
19. Estimate costs, help prepare bid specifications.	19.1 Knowledge of standards and practices used by estimators. 19.2 Knowledge of requirements for bid specifications. 19.3 Knowledge of current costs of materials. 19.4 Knowledge of current labor rates. 19.5 Knowledge of mathematics. 19.6 Skill in combining knowledge of labor and material costs.
20. Order job needs using approved procedures.	20.1 Knowledge of supplies and small general use parts for a job.

TASKS	SKILLS/KNOWLEDGES
	20.2 Knowledge of approved ordering procedures.
	20.3 Skill in maintaining adequate but not excessive job needs of supplies and general use parts.
21. Schedule equipment and material for efficiency.	21.1 Use knowledge of heavy equipment requirements and job needs for maximum utilization of heavy equipment.
	21.2 Plan equipment, material and supply delivery to minimize theft and damages.
	21.3 Have knowledge of all material requirements so work is not delayed because of shortages.
22. Organize manpower needs for most efficient operation.	22.1 Know how to utilize helpers for most efficient work.
	22.2 Skill in organizing jobs so that minimum man hours are expended.
23. Provide required data for cost accounting systems.	23.1 Knowledge of accounting systems.
	23.2 Keep accurate records of time and materials by classification system in use.

TASKS	SKILLS/KNOWLEDGES
24. Satisfy the physical requirements of the job.	24.1 Knowledge of proper methods of lifting and handling of heavy material. 24.2 Has knowledge of personal strengths and weaknesses and has learned to compensate for the weaknesses. 24.3 Has developed specialized manipulative skills required in this work.
25. Plan a safety program for each job.	25.1 Know the provisions of the Federal Health and Safety Act (1971). 25.2 Knowledge of planning a job for maximum safe conditions.
26. Follow safe practices and procedures.	26.1 Knowledge of safe practices and procedures including inherent hazards and dangers to guard against. 26.2 Skill in working in a safe manner.
27. Administer first aid.	27.1 Knowledge of first aid procedures. 27.2 Skill in applying first aid techniques. 27.3 Knowledge of sources of first aid training for currency and upgrading.
28. Write clear and concise communications.	28.1 Knowledge of the language.

TASKS	SKILLS/KNOWLEDGES
	28.2 Knowledge of special words and terms associated with the industry.
	28.3 Knowledge of good grammar and spelling.
	28.4 Skill in technical writing techniques.
	28.5 Skill in organizing thoughts and ideas for written communication.
29. Orally communicate ideas and instructions.	29.1 Knowledge of the language and special terms.
	29.2 Skill in oral communications.
	29.3 Skill in questioning the communicant to determine proper understanding of ideas and instructions.
30. Read instruction manuals, directions and other written material for precise content.	30.1 Knowledge of the language and terms of the industry.
	30.2 Skill in reading technical writing, charts, graphs, statistical data, and other techniques of technical communication.
31. Instruct and direct activities of subordinates.	31.1 Knowledge of management and supervision techniques.

TASKS	SKILLS/KNOWLEDGES
	31.2 Knowledge of psychology and sociology pertaining to the management of subordinates.
	31.3 Skill in communicating instructions so that the worker routinely accepts such direction.
32. Demonstrate effective relationships with customers and suppliers.	32.1 Skill in relations with people maintaining open and effective communication.
33. Maintain effective relations with superiors and coworkers.	33.1 Skill in getting along with other people.
	33.2 Skill in selling ideas to superiors and coworkers.
34. Work cooperatively with inspection personnel and engineers.	34.1 Knowledge of the duties and functions of inspectors and engineers.
	34.2 Knowledge of the requirements of the installation as related to the inspectors and engineering personnel.
	34.3 Skill in maintaining effective relationships with inspectors and engineers.

CHAPTER IV

NUMBER OF PRESENT AND ANTICIPATED EMPLOYEES IN ENGINEERING/INDUSTRIAL OCCUPATIONS

This chapter presents a breakdown of the number of present and anticipated employees for the occupational areas identified in Chapter I. The data from which these tables were developed was a continuing process of the staff throughout Phases I and II.

The majority of data for this chapter was taken from the data in the Florida Technician Manpower Survey for Duval County. This data was supplemented with a written survey which was mailed to 78 businesses and industries in Northeast Florida. Because of the lack of consistency in designating job occupations and titles by industry and due to the overlapping of occupational task/skills, a compiled total of technical occupations by category is given, rather than a specific number for each occupation title. A confidential supplementary report, not to be released publicly, gives the names of industries and agencies and their responses. This report will be part of the final project report.

Due to the competitive nature of the fields, both industry and unions are reluctant to express total number of employees or to make projections.

NUMBER OF PRESENT AND ANTICIPATED EMPLOYEES

ENGINEERING AND INDUSTRIAL

Position Identification	Number of Current Employees	New Employees Anticipated 12 Months
Electro-Mechanical		
A. Electronics Technician (includes the following specific job titles)	669	42
1. Electronics Installation Man		
2. Communications Technician		
3. Industrial Electronics Maintenance Man		
4. Electronics Salesman		
5. Radio and T.V. Repairman		
B. Electro-Mechanical Technician (includes the following specific job titles)	180	23
1. Instrument Repairman		
2. Machinery Maintenance Man		
3. Computer Maintenance Man		

NUMBER OF PRESENT AND ANTICIPATED EMPLOYEES

ENGINEERING AND INDUSTRIAL

Position Identification	Number of Current Employees	New Employees Anticipated 12 Months
Positions in Climate Control		
A. Climate Control Technician (includes the following specific job titles)	236	55
1. Air Conditioning, Refrigeration, Heating Serviceman		
2. Leader Man - Foreman		
3. Estimator		
4. Heating and Power Plant Technician		
5. Sheet Metal Man		

NUMBER OF PRESENT AND ANTICIPATED EMPLOYEES

ENGINEERING AND INDUSTRIAL

Position Identification	Number of Current Employees	New Employees Anticipated 12 Months
Transportation		
A. Transportation Technician (includes the following specific job titles)	246	40
1. Automotive Technician		
2. Engine Mechanic		
3. Service Station Business Man		
4. Truck and Equipment Mechanic		
5. Service Representative		
6. Operating Engineer		
7. Air Frame and Engine Mechanic		

NUMBER OF PRESENT AND ANTICIPATED EMPLOYEES

ENGINEERING AND INDUSTRIAL

Position Identification	Number of Current Employees	New Employees Anticipated 12 Months
Building and Construction		
A. Drafting Technician (includes the following specific job titles)	540	89
1. Architectural Draftsman		
2. Civil Draftsman		
3. Electrical Draftsman		
4. Mechanical Draftsman		
5. Surveyor		
B. Electrical Technician (includes the following specific job titles)	560	106
1. Construction Electrician		
2. Industrial Electrician		
3. Electrical Estimator		
4. Electrical Salesman		
5. Electrical Inspector		
6. Electrical Trainee		

Position Identification	Number of Current Employees	New Employees Anticipated 12 Months
C. Mechanical Technician (includes the following specific job titles)	121	14
1. Utility Technician		
2. Plumber and Pipefitter		
3. Industrial Sheet Metal Mechanic		
4. Steamfitter		
5. Mechanical Estimator		
6. Mechanical Inspector		
7. Mechanical Trainee		

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the conclusions and recommendations of the Project Staff as they relate to the Engineering and Industrial Area of technical education.

This chapter did not appear in the original summary report due to the fact that sufficient time was not available to review the findings with each of the Special Area Advisory Committee members. The staff also felt that feedback and recommendations from the Joint Planning Committee and the General Advisory Committee would be beneficial to have before any summaries were written.

Therefore, the comments included in this section represent the opinions of individuals with expertise in the Engineering and Industrial Area who have reviewed all available data. Such opinions should not be considered final or mutually exclusive of other judgments in that they are only presented here as a summary of the Project Staff's findings.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

As the nation's standard of living moves steadily upwards, there is an acceleration in the demand for certain kinds of goods and services . . . those for which demand is elastic and which are purchased with so called discretionary income. Television sets, long distance phone calls, central air conditioning, travel and vacations, and more and better housing are all within this category. We are becoming a nation in which the second home is a middle class phenomenon and more than one television set is quite commonplace.

But, besides the sheer volume of an increasing requirement for all kinds of goods and services, there is a developing trend towards demanding better quality. There is a growing desire to return to standards of workmanship and precision, which were not always adhered to in the rapidly expanding economy of the 50's and 60's. This means, in many cases, that more manhours may be expended to accomplish a particular task.

In the survey area alone, new positions during the next twelve months will total from 10% to over 30% of current employment in the areas included in this report, and these figures reflect essentially current, on-going industrial activities, and do not allow for new industries in the area or an upward change in the economic growth rate.

In terms of specific trends which contribute to the need for pre-technical curriculum materials in the engineering and industrial fields are the following:

1. Electro-Mechanical

There have been predictions that within a decade, large numbers of homes will be equipped with computer terminals and served by comprehensive information systems. Moreover, the "home entertainment center" of the future is likely to be supplied with video tape and/or cable systems as well as other multi-media devices. The age of the auto has yielded to the age of the electronic circuit.

In addition, the ground and water vehicles of tomorrow will increasingly rely on electronic components as is currently the case with aircraft. And, furthermore, the number of private aircraft is expected to continue to grow.

2. Climate Control

So called central air conditioning or climate control systems are no longer regarded as a luxury. This is reflected in its provision in publically supported housing and its emergence in FHA standards. And this is true in all parts of the country. Where temperature factors are not paramount, climate control systems serve to filter, humidify or dehumidify. In fact, in urban areas with high levels of air pollution they can almost be treated as a health necessity.

3. Transportation

In his 1972 budget message, President Nixon pledged to "get a man down town and back". It is recognized that doing this on the scale required may be far more difficult than having arranged round trip transportation to the moon!

More and more money is being allocated to the development and maintenance of transporation systems. Experiments and demonstrations are currently underway involving "individual rapid transit", "demand" scheduling and routing of buses and other innovations. Subway building is by no means over, and the Wankle Motor is being seriously tested. The transportation industry is entering a period of enormous growth, and we must begin to train technicians now, if needs are to be met.

4. Building and Construction

Experiments have shown that over crowding and living in very close quarters may have quite deleterious effects on individual and group well-being. Clearly, providing adequate housing for all our citizens is a very urgent social goal. And there have been estimates that, depending upon guidelines adopted, as much as 25% of our housing may be classified as substandard.[1]

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[1] FHA bulletins and reports

Thus, even if no new housing is considered, we would have an enormous task before us, merely replacing or up-dating existing substandard dwelling units.

Besides residential housing needs, industrial growth requires an accelerated rate of building and construction. Moreover, a condition of high technology means that obsolescence of plants and factories is becoming more rapid. With the pressure of international economic competition, obsolete production facilities can scarcely be tolerated.

In all, technical training for building and construction is clearly a high priority area.